# U. S. DEPARTMENT OF AGRICULTURE

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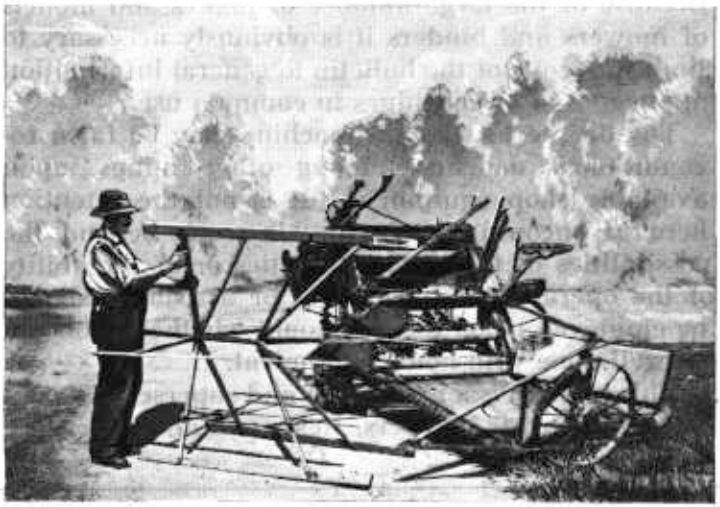
# Care and Repair of Mowers and Binders





MOWERS AND BINDERS represent a substantial investment on farms in practically every section of the country. These machines lend themselves readily to repair or reconditioning for additional service, as, in the main, they are the assembly of many different replaceable parts or units. Undoubtedly machines are constantly being discarded though still capable of additional useful performance if reasonable repairs or replacements were made.

A machine kept in good repair and in proper adjustment will last longer and do better work than one which is not. Also the former is less likely to cause costly delay at harvest due to machine failure. This bulletin contains information intended to aid the farmer in making needed repairs and adjustments and thus expedite harvesting operations. Because of the large number of makes and models of mowers and binders it is obviously necessary to limit the scope of the bulletin to general information applicable to all machines in common use.

The degree to which a machine may be farm reconditioned depends, among other things, upon available shop equipment. It is not the intention here to encourage farm repair work beyond the possibilities of farm shop facilities or of the ability of the operator. Expert labor or assistance should be employed when there is doubt whether a job can be well done with home equipment.

This bulletin is a revision of and supersedes Farmers' Bulletin 947, Mowers, Reapers, and Binders.

Washington, D. C. February 1936

# CARE AND REPAIR OF MOWERS AND BINDERS

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## INTRODUCTION

HAY AND GRAIN of good quality are most likely to be obtained when the crop is cut at the proper time. Considering the comparatively short period during which the crop may be harvested to best advantage, the time for cutting should be as fully utilized as possible. Putting the machine in the field in the best possible working condition affords some assurance against delays due to machine failure. Further assurance is provided in the ability of the operator to make emergency repairs quickly and intelligently, assuming adequate shop facilities.

Fundamental principles found in the earlier mowers and binders have been generally retained in the later machines although improvements have been made in recent years resulting in more efficient work and less trouble and delay. Lighter and stronger materials of construction, more general use of roller and ball bearings, improved lubrication, and new or improved units and adjustments have been provided. There is, too, more choice in the selection of the type of machine best suited for the work and in the equipment and attachments available to meet special crop requirements or conditions.

Undoubtedly many machines have been scrapped and many more are likely to be, while still capable of doing several years of useful work if a small sum were expended upon them for repairs. The proper time for overhauling a machine is during its period of inactivity and before the rush of spring work. If overhauling is put off until the machine is needed, failure to obtain repair parts promptly, press of other work, and the hazy recollection of the past season's difficulties may result in costly delays.

## MOWERS

The different parts or attachments of the mower are assembled on a main frame, and are readily accessible for repair or replacement (fig. 1). While a comparatively simple machine, many of the adjustments on the mower, particularly on the cutting mechanism, are of an exacting nature. Draft tests on a 5-foot mower showed that when cutting with a dull knife with guard plates in poor adjustment, from 30 to 35 percent more power is required than when the knife is sharp and guard plates are in proper adjustment and that but very

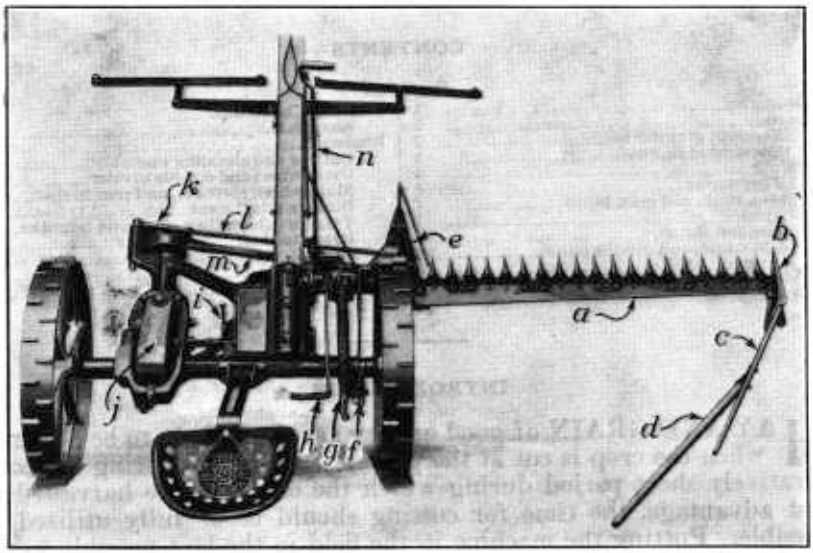


FIGURE 1.—Rear view of one standard make of mower: *a*, cutter bar; *b*, outside shoe; *c*, grass board; *d*, grass stick; *e*, inside shoe; *f*, tilting lever; *g*, lifting spring; *h*, foot lifting lever; *i*, clutch lever; *j*, gear housing; *k*, flywheel shield; *l*, adjustable tiebar; *m*, pitman; *n*, hand lifting lever.

little is to be gained by sharpening the knife and leaving the guard plates in poor adjustment.

In overhauling the mower for the next season's work, the cutter-bar assembly is a logical starting place, although the actual repair work should not begin until the entire machine has first been checked over to avoid duplication of work. In doing this, a definite sequence should be followed.

### ALINEMENT OF CUTTER BAR

A cutter bar is in proper alinement when the center of the pitman box, the knife head, and the outer end of the knife bar fall in a straight line when operating. When machine travel is stopped the pressure exerted on the cutter bar is released, and the bar should come to rest with its outer end slightly in the lead or advance of its inner end. There are several methods of checking the alinement. One is shown in figure 2 and involves the following procedure: With the tongue blocked up to normal position of use and the lifting spring adjusted so that the inside shoe is just floating, run a straight-

edge or string parallel to the axle and extending beyond the outer end of the cutter bar. This line should be trued by measuring to it from each end of the axle, and should be held the same distance from the floor or ground along its entire length. After securely establishing the parallel, pull back the outer end of the cutter bar to take up the slack due to wear; then measure from the line to the rear edge of the knife at its outer and inner ends. The lead of the outer end over the inner end can then be determined. Manufacturers' recommendations as to the proper lead are not alike, and the operator of any particular machine would do well to find out and use what the maker recommends. Usually one-quarter inch for each foot of length of cutter bar is recommended.

On mowers of later type an eccentric adjustment is usually provided for alineing the cutter bar (fig. 3). On some machines a

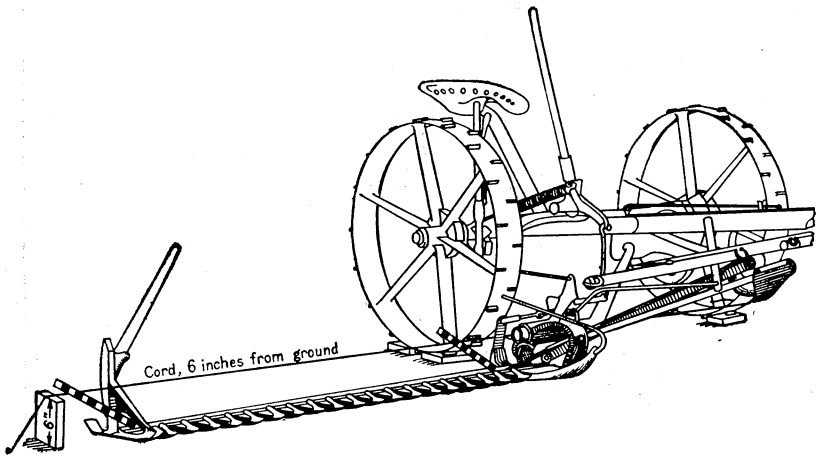


FIGURE 2.—One method of checking alinement of cutter bar.

step collar is provided in the yoke, together with an adjustable tie-bar just in front of the pitman. When this method of adjustment is made the register of the knife should be checked (p. 6). Improper lead may frequently be corrected by taking the play out of the yoke pins. Where the holes in the yoke casting have been worn oblong by the pins, which is usually the case, it may be necessary to bore an oversized hole and fit in a larger pin.

When the machine is operating it is difficult to detect, by observation, just when the cutter bar is out of alinement, and therefore it should be checked periodically. A cutter bar out of alinement will do a poor job of cutting and cause heavier draft.

### ALIGNMENT OF GUARDS

With the knife removed, guards which are badly out of alinement may be detected by sighting along the guard bar. Take a straight piece of strap iron or a steel straightedge 15 to 20 inches long and move it along the top of the guard plates *d*, figure 4, *A*, noting which plates are high and which are low. In doing this pay no attention to the points of the guards. Drive the guard

which is out of alinement back into place by a sharp blow of a hammer at a point on the guard where the stock is thick. In replacing a broken guard with a new one, the guard plate may be too high. This can be remedied by putting tin shims between the guard and the cutter bar when bolting on. Broken or badly worn guard plates may be replaced and brought into line with shims as for a new guard.

On stony ground the guard wings—the side projections of the guard—may become bent up, down, or sidewise. The function of such a wing is to help hold the guards rigid and to guide the cut

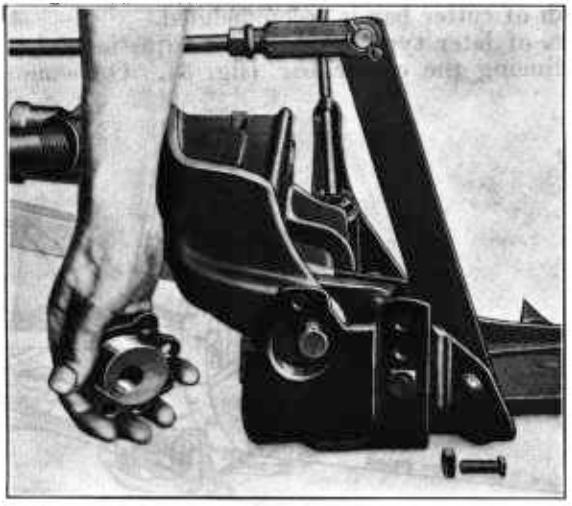

FIGURE 3.—Eccentric adjustment for alinement of cutter bar on some mowers.

grass out of the way of the knife. When bent, they should be straightened to conform as nearly as possible to the position of the other guards.

### KNIFE

A sharp, straight, well-centered knife sliding freely without excessive play makes for greatest efficiency. Since the knife is in constant danger of damage, an additional one should be kept on hand. There is, too, the advantage of always having a sharp knife to install when needed.

Examine the knife bar for bends, and if present remove them by straightening on a flat iron surface. If the cutter bar is provided with adjustable wearing plates they should be set to take up any play (fig. 4, *A*). The same is true of wearing parts in the knife head, and where these parts are badly worn they should be replaced, as excessive wear at this point frequently is the cause of a broken knife.

Knife clips or holders keep the knife flat upon the guard plates, and when the clips become loose or bent upward (*i*, fig. 4, *B*), the front end of the knife is allowed to rise and the result is a pulling rather than a shearing action. These clips should be adjusted only after the knife has been straightened and well centered. Starting

with the clip nearest the inside shoe, tap with light blows of a hammer until the clip just begins to tighten on the knife bar. Loosen the clip slightly and proceed with the other clips in the

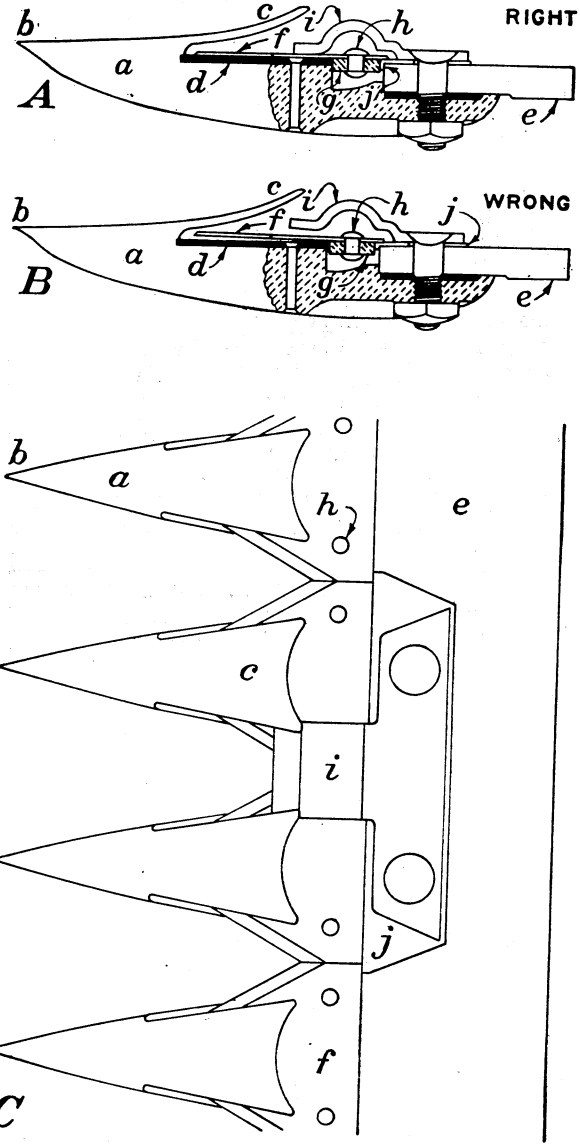


FIGURE 4.—Section and plan of cutter bar of mower: *A*, Section showing right method of adjusting clips; *B*, Section showing wrong method of adjusting clips; *C*, Plan showing relation of guards to knife. *a*, Guard; *b*, point; *c*, lip; *d*, guard plate; *e*, cutter bar; *f*, knife section; *g*, knife bar; *h*, rivet; *i*, clip or holder; *j*, wearing plate.

same manner. When all have been set, tighten them down securely. After this adjustment it should be possible to move the knife freely by hand.

An important adjustment of the knife is what is commonly known as its register. When each section of the knife at the end of its in-and-out strokes does not center on its corresponding guard, the knife is not properly registering. In such a case the cut is incomplete on the one stroke and excessive on the other, resulting in a poor job of cutting, frequent clogging of the knife, and mechanical unbalance. In checking the register tighten the pitman connections at each end, then, after raising the tongue of the mower to normal position of hitch, turn the flywheel first to one dead center and then to the other. If the knife sections do not center in the guards on the dead centers, adjustment is necessary. This is made on some machines at the tie-bar, which is threaded at one end, and where this is done it is sometimes necessary to change washers provided in the bar bearing in the yoke from one side of the bearing to the other. Knife-centering adjustments differ with the different machines, and the operator should examine the particular machine to see what provision exists for making adjustments and proceed accordingly.

In grinding knife sections preserve the same angle of cutting edge and bevel as that found on new sections. Many operators grind away too much of the point and too little of the heel of the section, and so change the cutting angle between the section and the guard plate. If a section becomes very much shorter than adjacent sections, it should be replaced by a new one.

To remove sections do not punch out the rivets, thus enlarging the rivet holes and weakening the bar. First remove the knife from the cutter bar, then lightly secure the knife sections in the jaws of a vise, with the knife bar resting on top of one jaw. A section of railroad iron or a similar object will answer if a vise is not available. Strike a sharp blow with a hammer downward against the back of the section at a point directly above each rivet. This shears the rivet neatly, and the sheared rivet may be removed from the bar with a punch.

In putting on new sections bear in mind that properly riveted sections seldom become loosened by wear. While a riveting set is desirable, a satisfactory job of riveting can usually be done with the exercise of a little care, using a ball-peen hammer. The center of the rivet should be high and well rounded and the edges worked down flat against the section.

### LIFTING SPRING

Proper tension on the lifting spring (fig. 1, *g*) transmits most of the weight of the cutter bar to the main wheels of the mower, allowing the bar to float easily over the ground, carrying just enough weight to hold it steady. A bar that drags heavily increases the draft and causes an excessive side draft. When this is in evidence, take up on the lifting spring tension but not enough to keep the end of the bar from following the contour of the ground. Closely associated with the lifting spring is the lifting linkage which should always be kept in proper adjustment to insure even raising of the cutter bar. There is usually provision for taking up wear in the linkage, but any change should be made only after checking for proper tension on the lifting spring.

### SHOES, STICK, AND GRASS BOARD

The set of the outside shoe should always be so as to keep the cutter bar level. Replace badly worn soles. When the wheel attachment is used see that a slight lead away from the grass is maintained, and, if this cannot be done by adjustment, replace the worn bearings. If there is difficulty in keeping a clear path for the inside shoe, examine the grass board and stick. Proper angle of the stick is important, especially in tall grass, in which the stick is raised to better clear the path for the next round. With some mowers a revolving-stick attachment is available which, when in action, throws the grass away from the end of the cutter bar. Proper adjustment of the grass-board spring should be maintained as otherwise the board may at some time be jammed sidewise and broken. The spring tension should be tight enough to prevent the flapping of the board and loose enough to render the board flexible to side pressure.

### PITMAN

End play may develop at either end connection of the pitman and can readily be detected by hand. Be sure the pitman itself is not warped or twisted, a condition sometimes found with wooden pitmans. The knife-head bearing is usually ball and socket, and if by lack of attention the socket has become elongated or the ball worn elliptical so that the lost motion cannot be taken up, the only remedy is to renew either or both the knife head and the pitman bearing. Many models of mowers are equipped with a knife-head connection which automatically takes up the wear as it develops. In tightening pitman bolts be sure there is no binding which would interfere with the up-and-down movement of the cutter bar.

Excessive play or pounding at the pitman-wheel connection is ample warning to the operator that attention is necessary. This usually calls for replacement of the crank pin, the pitman-box bushing, or both. The worn crank pin may be broken off, after starting the break with a hack saw, by striking with a hammer; then the small end of the pin is easily driven from the wheel. This installation should be done with the crank shaft removed from the machine, at which time replacement of the crank-shaft bushings may be made if necessary. Be sure the newly installed crank pin is straight in the wheel.

### GEARS AND CLUTCH

On many machines provision is made for adjusting the mesh of the gear on the countershaft and the bevel pinion by an adjusting nut on the end of the countershaft. On other machines the main gear or countershaft gear is shifted by an adjustable collar, or by placing washers behind the gear. If washers or gears are worn very badly it may be necessary to replace either or both. Countershaft bushings may be replaced when necessary as indicated under Bearings. See that the gear-control mechanism works smoothly and effectively. Take up wear in the clutch-shifter rod where possible, and check for possible binding of the clutch fork when the clutch is engaged.

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### MAIN WHEELS AND DRIVING PAWLS

If there is excessive end play in the main wheel bearings this should be taken up by means of the adjustment provided for this purpose. Power to operate the knife is usually transmitted from the main wheels by ratchet and pawls (fig. 5), hence their condition and adjustment are important. Neglecting this adjustment may result in broken pawls and pawl springs. See that the pawls engage at once when the machine starts forward. If the engaging faces of the pawls are worn unevenly, dress them with a file. When pawls are in the ratchets correctly, there should be a clicking noise when the wheels are turned backward. Any accumulation of dirt in the pawl boxes should be removed.

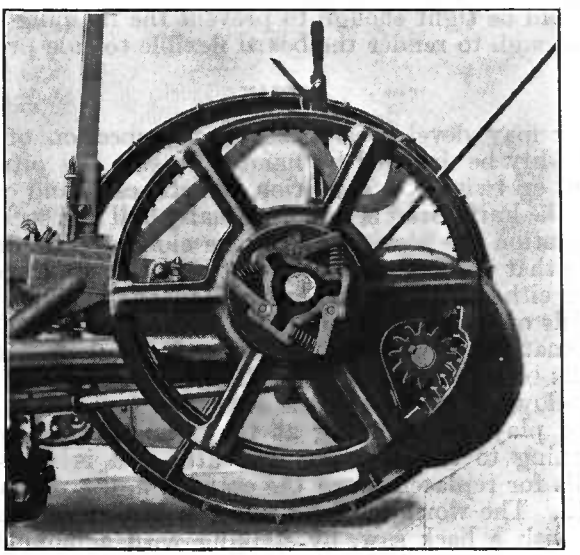

FIGURE 5.—Driving pawls for transmitting power from main wheels.

### BEARINGS

Provision for safeguarding the bearing surfaces differs somewhat with different mowers. Generally roller bearings are provided on the main axle, on the countershaft, and sometimes on the pinion end of the crankshaft. Bronze or brass bushings are commonly used on the front end of the crankshaft, in the pitman box for the crank pin, and frequently on the pinion end of the crankshaft. These bearings should be kept well lubricated and occasionally examined for wear. The crankshaft bearing surfaces are especially important, and when excessive play exists the bushings should be replaced with new ones.

Bushing replacements are neglected frequently because of the time and trouble involved. In removing the crankshaft preparatory to replacing the bushings, bear in mind, when removing the bevel pinion, that the thread of the pinion may be either right or left hand. Determine first how the pinion should be turned, instead of making trial turns in either direction with possibly disastrous re-

sults. After taking out the crankshaft, which requires usually but the removal of the pitman-wheel guard in addition to the bevel pinion, examine the bushings, and before attempting to drive them out be sure they are not held in place with set screws, and, if they are, remove the screws. The bushings are usually driven out by using a length of shafting slightly less in diameter than the crankshaft and 4 feet long or longer. This is run through the front bushing, and on through the housing until it contacts the near end of the other bushing. By striking on the free end of the shafting, the bushing is driven out. The second bushing may be driven out in a similar manner.

### GENERAL

The machine should be gone over to insure that all bolts and nuts are tight, lock nuts and cotter pins in place, and parts weakened by wear replaced. Attention, especially in hilly sections, should be paid to draft and neckyoke connections. Through wear and exposure to the elements these may be weakened so much that while normally appearing safe they may give way at an unexpected moment and a serious accident to horses or operator result. Acquire the habit of making frequent inspections of the machine.

Lost motion should be checked periodically, especially in machines that have been used for several seasons. When the knife does not start sliding with the forward movement of the machine, examine the pawls in the hubs, the clutch, the gears, the pitman-wheel bearings, and the knife-head connection. Where lost motion may be taken up at any of these points, it should be done; worn parts that cannot be taken up sufficiently should be renewed.

### LUBRICATION

In lubricating the mower, general recommendations of the manufacturer should be followed as nearly as practicable. Lubrication of exposed gears, by increasing lodgment of grit and dirt, may cause excessive wear and grinding out of the parts. This is especially true when operating in sandy soils. Enclosed gears should be kept clean and well lubricated.

Oil cups should be kept clean and care observed that the holes to the bearings are not caked with oil or dirt. Before beginning the season's work it is desirable to remove from the bearings accumulations of all foreign material. This may be facilitated by flooding them with kerosene. Kerosene is an effective cleaning agent, but it should be followed with a bath of lubricating oil as metal washed in kerosene tends to rust. It is best never to use kerosene on metal parts preparatory to storing a machine over the idle season. A wad of wool makes an excellent filter for filling oil cups; unlike cotton waste, it is not easily drawn into the bearings, is not subject to chemical action of lubricating oil, and does not become matted by use. A few drops of oil on the bearing surface of the knife bar when work is started with a new machine or an overhauled one will assist greatly in obtaining smoothness at this point.

Those parts not taken care of automatically should be lubricated little but often. Fast-moving parts such as the pitman connections, the crankshaft bearings, and the bevel-gear and gear-shift bearings

need frequent attention, while the slower moving parts, or those used but occasionally, need less frequent service. Abnormal heating of any part of the mechanism is a certain indication either of the need for lubrication or of improper adjustment of parts. Excessive heating is sometimes accompanied by damage to the part.

### STORAGE

At the end of the season's work it is well to make a list of needed repairs and adjustments. If this list is referred to when the mower is being overhauled necessary repairs and adjustments will not be overlooked. The mower should not be left in a fence corner or other out-of-the-way place for wooden parts to rot and metal parts to rust, which even during a short period may cause more deterioration than a season's use. A weather-tight, well-drained shelter with a fairly level floor to prevent machine strain should be provided.

When putting the mower away place boards under the main wheels; clean the knife, wipe it with a greasy rag, and store it in a dry place. Also place a block of wood or other support under the midpoint of the tongue so that it will not acquire a permanent sag. If stored with the cutter bar in a vertical position place a block of wood under the shoe to take the weight off the frame. All dirt and grease should be removed, and the bright parts oiled or greased.

Wooden parts should be kept adequately painted. The best treatment for the wooden pitman is an occasional application of warm, raw linseed oil. The metal pitman may be preserved by a good grade of paint.

## BINDERS

The binder is a more complicated machine than the mower, yet by a systematic study of the various parts and their relation to one another a working knowledge of the machine may be acquired.

### CUTTING AND ELEVATING ASSEMBLY

#### CUTTING MECHANISM

The cutting mechanism and its adjustment is somewhat similar to that of the mower. The sections of the sickle of the binder are, however, smaller and have serrated edges. The travel of the binder sickle section covers two full guards, and the sickle travel is much slower than that of the mower knife. Binder guards and guard plates are also smaller than those on mowers, and the plates are ground smooth. Less power is required in cutting the stems of grain; consequently the pitman is less rigidly braced and connected. Usually a wooden pitman is used with holes at each end for wrist-pin and knife-head connections. Provision is made for taking up wear in the pitman. The remarks regarding the cutting mechanism of mowers apply generally to binders.

#### REEL

During operation, the reel slats should strike the standing grain just below the heads and before the stems have been cut, in which case the grain is lifted and thrown back on the platform. In

short or lodged grain or grain that is leaning away from the platform it is necessary to set the reel low and possibly forward. With the reel set low possible damage to the slats, caused from striking the platform, may be avoided by tacking strips of heavy canvas to the outer edges of the slats to sweep the grain onto the platform.

See that the reel slats are not broken or badly sprung. Connections to the arms and the arm connection to the hub should be tight. The reels on most binders are placed so that the stubble end is given a lead over the grain end. This is to counteract the tendency of grain to elevate head-end first. The skillful operator shifts the position of the reel to meet the varying conditions of the grain.

Examine the reel-shaft bearings and if badly worn, renew. When a slip clutch is provided on the reel jackshaft, see that it is in proper tension. Start the adjustment with the clutch loose, then gradually tighten until the tension is sufficient for ordinary work but loose enough to slip in case of clogging.

If the reel is gear-driven and the gears become worn, examine them for proper mesh and make the adjustment accordingly. In bevel-gear drives, always secure proper mesh by adjusting both gears equally. If renewals are necessary, renew both gears, as 2 worn or 2 new gears run with less friction than 1 worn and 1 new gear. With sprocket and chain drive, the same procedure may be followed as for canvas-drive chains. Examine also the reel-shifting lever connections to see that all latches work freely and positively. Take up any lost motion possible. Renew broken or excessively worn parts and see that all connections are rigid and tight. The reel-shaft brace at the outer end of the platform is especially important.

### ELEVATING CANVASES AND CHAINS

Before putting on canvases, see that the rollers work easily, that they are straight, in good repair, and in proper alinement. If not properly alined, the canvas will not run straight. To determine whether the canvases are squared properly, a new machine may be tested with a carpenter's square. The frame of an old machine, however, may be sprung, and a better way is to test the lengths of the diagonals. If the diagonals are not of equal length they may be made equal by the adjustment provided for that purpose. If the elevator frame is not square, canvases will not run straight on rollers but will crowd against the elevator frame, thus tearing ends of slats loose from the canvas. The canvases should be run only tight enough to prevent slippage, and when the machine is not in use or is left overnight, tension on the canvases should be slacked off. In putting on canvas, see that the buckles lead in the direction of travel, and that each strap is drawn up to the same tension. Examine the roller bearings and if worn, replace.

Clean the canvas-driving chains thoroughly by scrubbing with a brush after soaking for a short time in kerosene; then rinse in clean kerosene. Examine sprocket-gear bearings, clean out oil holes, and if bearings are badly worn, renew. See that the sprocket wheels are in line. This can usually be tested by sighting across the faces of the wheels. If there is excessive end play take it up by placing

washers back of the sprocket wheels. See that the chain tightener is adjusted properly, not too tight but tight enough to keep the chain from slapping. When the length of the chain has been increased much from wear it begins to cut the teeth of the driving sprocket. Remove a link if possible rather than adjust the tightener to an extreme position.

### GRAIN WHEEL AND OUTSIDE DIVIDER

The grain wheel supports part of the weight of the platform and should receive frequent attention and lubrication. A slight lead toward the stubble should be maintained in the wheel; where, owing to wear, this cannot be done, a new bearing or wheel should be provided. Proper functioning of the grain wheel is necessary to prevent undue side draft.

The function of the outside divider is to guide the standing grain into the path of the cutter bar. See that it does this by keeping the parts in good repair and all connections tight. Some makes of binders permit of folding the divider back against the platform, which facilitates passage through gates and lessens the danger of breakage.

### MAIN WHEEL, SPROCKET, AND COUNTERSHAFT

The main wheel carries over three-fourths of the weight of the binder, and its care is important. In each end of the hub of the wheel large roller bearings are provided. These, together with the end-thrust bearings, should be occasionally inspected for wear and should be well lubricated. If badly worn, renew. Flush the bearings occasionally with kerosene to remove old lubricants and other accumulations. See that the raising and lowering devices work freely and that all fastenings are tight. If any parts are badly worn, renew.

Horse-drawn and some tractor-drawn binders are driven by chain drive from a large sprocket attached rigidly to the main wheel (fig. 6). This sprocket should line properly with the one on the countershaft. The alinement can be tested by sighting or, better still, by placing a straightedge across the faces of the sprockets, care being observed that the driving sprocket is not sprung and that all bolt connections are tight. If the shaft sprocket is not in its proper position it may be shifted into line.

Periodically the main chain should be removed, washed with kerosene, and scrubbed free of all accumulations of dirt. As the main wheel, when revolving, picks up much soil, it is advisable to use dry flake graphite on the main drive chain rather than oil or grease. When replacing the chain, if it is of the malleable-pintle type, be sure to run it with the narrow or bearing end of link forward on top of the driving sprocket with the oil holes up. If hook-link chain is used, the hook should go forward on top of the driving sprocket with the opening of the hook outward. See that the tightener is in good repair and renew the tightener wheel and bearing if badly worn. This should be adjusted properly to take up the slack in the chain, but not too tight. Here, as in all chain drives, it is better to shorten the chain by removing a link than to adjust the tightener to an extreme position.

The countershaft is on the frame in the rear of the main wheel and parallel with the axle (fig. 6). It is driven by a sprocket and carries the clutch and the bevel gear which meshes with the pinion gear on the crankshaft. Examine the mesh of all gears, and where bevel gears are used and badly worn replace both gears with new ones. On the newer binders proper mesh between the countershaft bevel gear and the pinion gear on the crankshaft is maintained by a set screw at the opposite end of the countershaft exerting a constant pressure against a ball-thrust bearing. Examine the countershaft bearing and if badly worn, renew. These also should receive proper lubrication, and be flushed occasionally with kerosene.

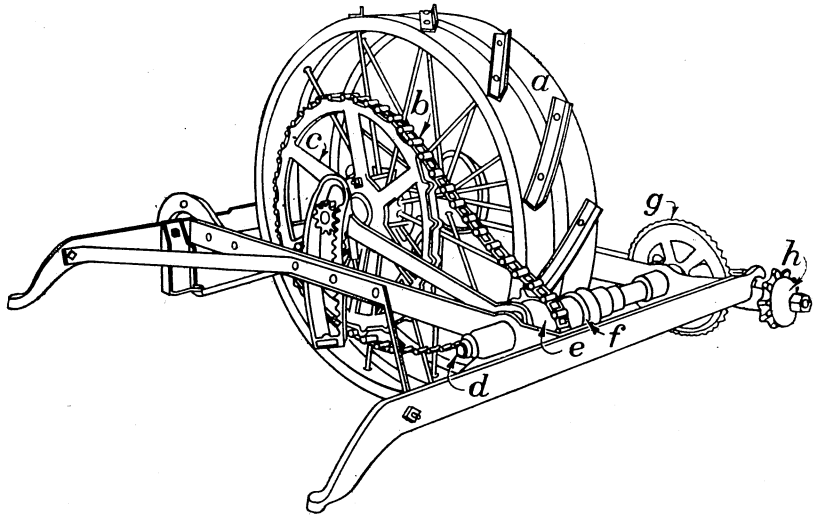


FIGURE 6.—The main wheel and the countershaft assembly of a binder: *a*, Main wheel; *b*, drive chain; *c*, drive sprocket; *d*, adjustable thrust bearing; *e*, shaft sprocket; *f*, clutch; *g*, bevel gear, *h*, crankshaft sprocket.

Sprocket *h* in figure 6 on the end of the crankshaft drives the binding attachment, the packer shaft, and the elevators. This sprocket may either be keyed or screwed on the shaft. If removed, care should be exercised that it be not damaged.

### BINDING ATTACHMENT

The binding attachment (fig. 7), which includes the knotter and knotter shaft, needle, packers, and discharge arms, works independently of other binder parts and may be shifted as a unit forward or backward according to the position of the band on the bundle. Adjustment in position is necessary in order that the band may be kept at the desired location on the bundle when grain of varying lengths is bound.

Variation in design and adjustment exists with the various makes and models of binders, but the same general method of cutting and binding is used. The grain is cut and carried on a platform canvas to two elevator canvases, between which it is carried to the deck of

the binder on which the bundle is formed and tied. The upper elevating canvas on some binders is floated, which automatically takes care of light or heavy grain. The deck is inclined downward to start the grain toward the position where the bundle is formed. On its way down the deck the butts of the grain are evened up by a lever-controlled butt adjuster. The downward movement of the grain is further aided by packer arms, which force the grain into a compact bundle against the compressor arm. After the bundle is completely formed, the needle passes the twine around it, engaging the twine in the knotter head.

The knotter head itself requires most exacting adjustment and coordination of parts, and it is here that the majority of binder

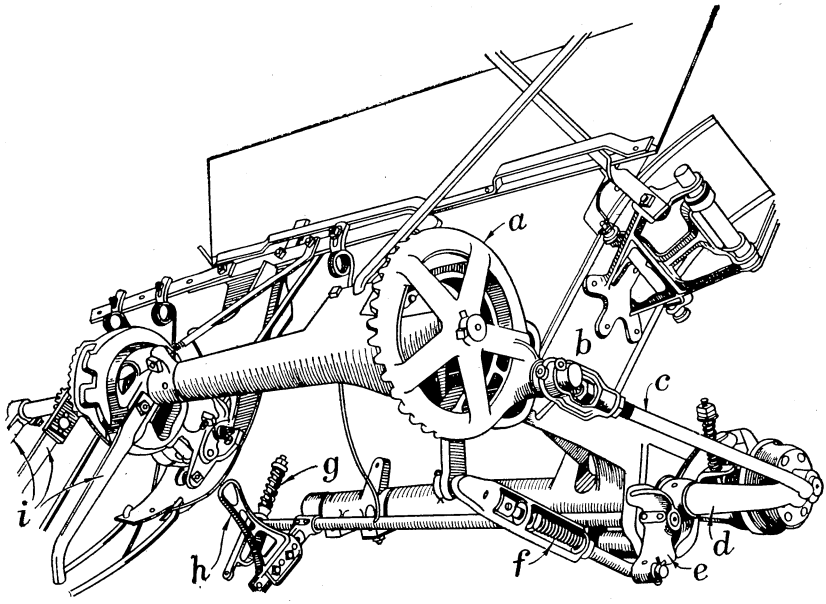


FIGURE 7.—Binding attachment: *a*, Cam gear; *b*, butt adjuster; *c*, needle pitman; *d*, needle shaft; *e*, binder trip; *f*, trip hook spring; *g*, compression spring; *h*, compression arm; *i*, discharge arms.

troubles occur. A knowledge of its operation and adjustment is indispensable in correcting tying troubles. The general principle upon which the knotter operates is as follows: As the bundle is forming, one end of the twine is held firmly by the twine disk, the twine running back over the knotter bills, through the stripper arm, and under the bundle to the needle. When the bundle is completely formed and ready for tying, the pressure (usually about 20 pounds) exerted by it on the compressor arm (fig. 7, *h*) releases the binder trip, thus setting the binding mechanism in operation. At this time the needle advances (fig. 8, *A*), putting the twine over the knotter bills and into the disk, which latter then turns sufficiently to hold the twine securely. With the needle still advanced, the bills now revolve, forming a loop in the twine. As one revolution is nearly completed, the bills open to grasp the needle ends of the twine (fig.

8, *B*) which are held tightly between the closed bills at the completion of the revolution (fig. 8, *C*). At this stage the knife on the stripper arm advances sufficiently to cut the twine free from the disk. The cut ends of twine are still held by the bills and are pulled through the loop as the stripper arm advances and strips the loop off the bills, thus tying the knot. In figure 8, *D*, the needle is shown receding after the knot has been tied, laying the twine in the next notch of the disk (*e*) in preparation for the next bundle.

Obviously, all moving parts must work in unison. Any necessary adjustment should be made with precision and with due regard to the exacting nature of knotter-head adjustments. With this in mind,

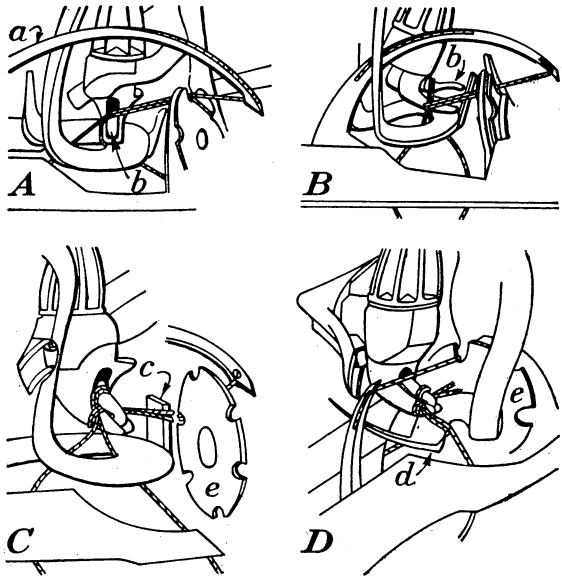


FIGURE 8.—Knotter head of a standard make of binder showing tying process in four steps: *A*, Needle (*a*) advancing; *B*, bills (*b*) opening to grasp twine; *C*, bills closed and knife (*c*) advancing to cut twine; *D*, needle receding and twine about to be stripped from bills by stripper arm (*d*), twine for next bundle placed in notch of disk (*e*).

before removing any part, examine the attachment for any timing marks which may have been placed on them by the manufacturer. These are usually projections placed on a pair of opposite cogs in gears meshing together, or may be some symbol stamped into the metal. If no marks can be found, difficulty in assembling may be obviated by making timing marks with a small, sharp cold chisel. A good mechanic, in taking down any piece of machinery, does so in a systematic manner, with due regard to the relation of the parts, so that in assembling them the bolts and attachments are put back in their original positions.

An important consideration in tying the bundle is tension of the twine held by the disk. As the bills of the knotter revolve, the twine is pulled through the disk in tying the knot. The tension hence should be loose enough to prevent breaking of the twine and tight enough to prevent excessive slippage. Usually a tension of

from 35 to 40 pounds is about right. The twine tension of the needle is also important. Usually from 6 to 8 pounds is sufficient; if the tension is much in excess of the normal tension a groove will be worn in the eye of the needle, and tying troubles will result.

Similar needle trouble may be caused by failure of the needle to advance far enough to replace the twine in the disk holder, because the needle is bent, or because of normal wear. When due to wear, this condition is corrected by shortening the needle pitman (fig. 7), for which adjustment is provided. In adjusting the needle for proper advance, care should be taken that the needle does not strike too hard in the knotter head. Whether this is the case may be determined by slowly turning the mechanism by hand. If it is, the necessary adjustment can then be made. At rest, the point of the needle should protrude about three-quarters of an inch above the deck.

Proper tension on the knotter-bill spring is important, since excessive tension may result in broken twine and insufficient tension in loose knots on the band, or the ends of the band may remain straight and unknotted. In adjusting the knotter-bill spring, make trial adjustments of one-quarter turn on the adjusting screw until the trouble is corrected. If, after a reasonable number of trials, the trouble still exists be sure to set the spring back to the tension it had before the adjustment was started. Failure to do this frequently adds to the difficulty in tracing the real trouble.

Only the best quality of twine should be used in binders. Poor-quality twine or twine having much variation in thickness may sooner or later lead to delay because of tying troubles.

Never attempt to regulate the size of bundle by adjusting the twine tension. The space between the packers and the compressor arm, assuming normal trip-spring tension, determines the size of bundle; setting the compressor arm in toward the packers decreases, while setting the arm out away from the packers increases the size of bundle. Some binders have an additional and independent trip arm which, when adjustable, may be set lower to increase, and higher to decrease the size of the bundle contingent upon the compressor-arm changes. Tighter bundles may be had by tightening and looser bundles may be had by loosening the trip spring. If the grain is ripe and dry, adjustment should be made for large, tight bundles, and if wet or green, for small, loose bundles. Choking of the machine in discharging bundles may sometimes be traced to abnormally large or tight bundles, especially if they contain green material.

Eliminate the possibility of knife trouble. See that the knife is in proper position and, if broken or in bad condition, replace; if dull, sharpen, using a small carborundum stone or a good mill file. In sharpening the knife, maintain the original bevel and avoid scratching other parts of the knotter.

### TYING TROUBLES, THEIR CAUSE AND REMEDIES

The tying mechanism should not be tampered with, in case of tying trouble, until every other possible source of trouble has been eliminated. With a new binder, it should be remembered that the machine was tested and adjusted at the factory and should function properly unless the adjustments have been tampered with. If unbound bundles are thrown out at the beginning of the cutting

operations of a new binder, or in one that has been overhauled, do not attempt to make adjustment, but proceed for a short distance until satisfied that the trouble lies in the knotter and is not due to paint or rust, which should soon wear off. If knotter bills are very rusty or coated with paint, polish them with emery cloth.

If adjustment is necessary, make it gradually. If too great changes are made in one part of the mechanism, troubles may develop in other parts. A good plan in tracing tying failure is to begin with a clean binding attachment. Then start the machine in the grain, and when the first bundle is missed or untied stop the machine. Locate the band and note its characteristics, as from these the cause of trouble may be determined, after which proper adjustment may be made. Figure 9 shows a number of trouble bands.

If the band is found clinging to the knotter hook or bills with both ends cut off square as shown in figure 9, *a*, it indicates that the

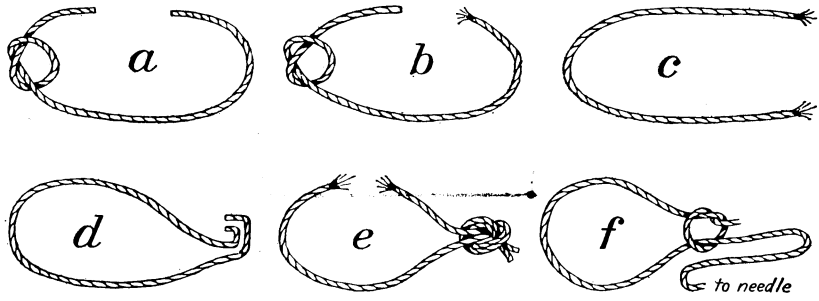


FIGURE 9.—Trouble bands found on the knotter bills or on cast bundles: *a*, Both ends cut square; *b*, free end ragged or crushed; *c*, twine without knot, both ends ragged; *d*, ends folded; *e*, tied but broken; *f*, tied with slip noose.

twine disk is too loose or the twine tension too tight. To remedy this, loosen the tension, and if this does not correct the trouble tighten the disk spring slightly. This spring is located on the back of the disk. If a band in this condition is with the bundle, tighten the disk spring and if this does not overcome the difficulty examine the disk for wear. If badly worn, replace the disk with a new one. If this occurs regularly with each fifth, sixth, or seventh bundle look for wear in one notch of the disk. A very loose or broken twine tension may be the cause of the twine not being stretched tightly across the bills.

If the broken band is found on the bills with the free end ragged or crushed as indicated in figure 9, *b*, loosen the twine tension; if this does not correct the trouble loosen the disk spring slightly. If such a band is found with the bundle, loosen the disk spring. This condition may also be caused by the disk being out of time, in which case it should be adjusted for timing.

If the band is found with the bundle, with both ends straight and free from knots and both ragged and crushed (fig. 9, *c*), the tension is right, but the disk spring is very tight. The remedy is to loosen the disk spring.

If the band is found with the bundle, with both ends free from knots and folded, showing that the knot was formed but not completed (fig. 9, *d*), examine the bills. The trouble may be due to

foreign material under the upper knotter bill and in the groove of the lower bill. The bill spring may be too loose or the hook or bills worn so badly that the ends of the twine were not held sufficiently tight to form a knot. The remedy is to tighten the knotter hook or bill spring, or if there are signs of excessive wear, replace the knotter hook or bills and shaft complete.

If the band is found either with the bundle or clinging to the bills, with the knot perfectly formed but the band broken (fig. 9, *e*), the trouble may result from the bill spring being too tight when tying loose bundles. The remedy is to loosen this spring slightly, or set the binder head to bind larger and tighter bundles. Additional causes for this trouble may be a worn cam roller on the stripper arm, a bent stripper arm, and very loose twine tension. Replacement, repair, or adjustment should be made accordingly. Such trouble occurring when an old binder is first taken into the field points strongly to rusty or rough bills. Examine the bills, and if such is the condition, remedy it.

If the bundle is tied with a slip noose with the twine extending from the discharged bundle to the needle eye (fig. 9, *f*) the needle has failed to place the twine in the disk holder either because it is bent or because there is excessive wear in the eye of the needle itself. If the needle eye does not have a special wearing piece, the only remedy is to supply a new needle.

### POWER TAKE-OFF

In operating a power take-off binder, bear in mind that an uninterrupted harvest depends as much upon a well-performing tractor as upon a well-performing binder. Since the power take-off shaft is controlled by the engine clutch and the belt-pulley gear-shift lever on the tractor, see that these parts are functioning properly. In operating, care should be exercised in regulating the speed of the tractor so that a normal flow of grain to the binding head is maintained. In heavy or lodged grain a slow tractor ground speed should be used, but the engine should be kept at its rated speed to maintain normal operation of the binder mechanism.

The power shaft runs in roller bearings and is provided with universal joints. Both bearings and universal joints should be kept well lubricated and occasionally examined to insure smoothness of operation and lessen the wear of the parts. Where the power shaft is provided with a slip clutch, see that it is in proper tension. Avoid sharp or quick turning, and when a short turn is necessary slow down the tractor speed. The power shaft revolves rapidly, and though it may be partially safeguarded, constant precaution should be taken to avoid personal injury or damage caused by loose clothing or other material being caught by the shaft.

Power take-off binders, like other tractor binders, are constructed more sturdily to withstand loads and strains heavier than those imposed by horse-drawn binders. In principle, however, they are similar to horse-drawn binders.

### GENERAL

In general, the tilting lever and connections, binder-shifting levers, bundle-carrier trip, butt-adjuster lever, and reel-shifting

levers should be examined to see that they work freely and positively. Those parts showing excessive wear should be renewed and all fastenings made tight. The main frame should be gone over to see that all connections are tight. Broken or bent frame braces should be renewed or straightened. Draft and seat connections should be examined to see that all are tight and that all lock nuts and cotter keys are in place.

Excessive draft should be watched for. When the binder seems to be laboring abnormally, stop and inspect the machine. The causes for excessive draft are many and varied, one or more of which, if unchecked, may result in serious damage to the binder. In tracing the trouble check the lubrication, tightness of chains, mesh of gears, and freedom of moving parts, especially rollers and canvases.

### LUBRICATION

The operator should know the location of all oil holes on the machine and lubricate in a systematic manner so that no bearing is neglected. He should see that all oil holes are clear and not trust to chance that some oil will reach the bearing. He should apply only enough oil to effect the desired purpose. If oil is smeared over adjacent parts, the excess should be removed with a rag so as not to afford lodgment for grit, which may subsequently work into the bearing. Before applying a lubricant to a high-pressure fitting, be sure the fitting is clean; then see that the lubricant gets to the bearing and does not accumulate on the outside of the fitting. Adequate lubrication in such a case is assured when oil becomes visible at the ends of the bearing. When lubricating, look for loose bolts or parts out of adjustment. A loose bolt or nut may lead to the breakage of a part which, although inexpensive, may cause several days' expensive delays in the rush of the harvest season. Oil cups should be packed with a filter of wool, which is more satisfactory than cotton. Before starting harvesting operations it is a good plan to put the mechanism in gear and operate the machine for a short distance. This helps to loosen up the machine and indicates whether all parts are functioning properly.

### STORAGE

At the end of the season, a list of the needed repairs and notes regarding the season's difficulties should be made and filed for future reference, when repairs may be made more conveniently.

In preparing the machine for storage, remove the canvases, wrap them carefully, and store in a dry place away from mice or rats, or hang in a dry place on a round stick with ends free and even, so that mice and rats can find no place for nests.

Apply a good leather dressing, harness oil, or tallow to leather straps to prevent them from becoming dry and hard and cracking in use. Never apply a mineral oil to leather. The knife and wooden pitman should be stored in a dry place. The knife should be cleaned and greased. The pitman should be stored on a shelf or flat place so that it will not become sprung or warped. Grease the guard plates, knotter, and twine holder, needle point, twine eyes, and all bright parts of the machine and binding mechanism. The chains

should also be removed, cleaned with kerosene, wiped dry, and oiled. They should be labeled, tied in a bundle, and hung in a dry place. Some or all of the reel arms as well as the tongue may be removed if storage space is at a premium. If any wooden parts are removed they should be stored in a dry place and in such a manner that they will not warp. All bolts and washers should be replaced in the part from which they were removed. If the tongue is not removed it should be supported by blocking at the draft connection so that it will not acquire a permanent set. The bearings throughout the machine should be oiled with a heavy oil which will not run out readily.

As with other machinery, wooden parts do not warp or decay as readily if repainted frequently. Reel slats and arms, outside dividers, tongue, neckyoke, singletrees and doubletrees, deck, guides, etc., come within this class. An application of warm, raw linseed oil is best for the wooden pitman and canvas rollers.

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